Self-Spotting Safety Bench Press

This application is a continuation-in-part of pending patent application Ser. No. 10/123,932, filed April 16, 2002.

Background of the Invention

(1) Field of the Invention

This invention relates to free weight exercise equipment, and specifically to an improved self-spotting bench press.

(2) Description of the Prior Art

The use of barbells, i.e., free weights, for conditioning and enhancement of the body's musculature is widely practiced by a variety of people. Often, these people prefer to weight lift in the privacy of their home, and when they feel like weight lifting.

Most common weight training is executed with a spotter, i.e., someone who can assist the lifter when they become fatigued or are having difficulty or are about to drop the weight. Style, communication, consistency and reaction time are all factors that vary when being spotted. These factors are major deterrents to using a human spotter. However, to weight lift without a spotter may be dangerous to the weight lifter. Without a spotter to grab the barbell and prevent the barbell from dropping on the weight lifter, there is a significant danger of serious injury due to fatigue or improper technique. This danger exists in situations from private to professional weight lifting.

The danger of crushing ones chest performing the bench press exercise is a great concern. U.S. Patent No. 5,989,164 to Kullman et al (1999) shows a device that lifts the weight from the lifter's chest. While this device removes the weight from the lifter's chest, it utilizes cables that increase setup time and can cause increased or decreased resistance due to contact with the barbell. U.S. Patent 6,086,520 to Rodriquez (2000) shows a device that also

lifts the weight from the lifter's chest using a spring/motor combination. This device lacks the ability to adjust the amount of assist, and rate of lift to each lifter's preference. U.S. Patent 5,310,394 to Killios (1994) describes a spotting machine that requires power to operate an electric motor that limits the machine to an area supplied with a power source.

All the machines heretofore known suffer from one or more of the following disadvantages:

a. Not being adjustable to suit each individual lifter's spotting preference, such as whether the spotting mechanism should assist the lifter by removing a fraction of the weight, remove all the weight, or not be used at all, and rate at which the spotting mechanism lifts the weight.

b. Not enabling the lifter to continue repetitions while being assisted by the spotting device and still having the ability to lock the spotting device preventing the weight from falling on or crushing the lifter.

c. Requiring electrical power.

d. Using barbell attachments such as cables that impede motion.

e. Using a greater quantity of material and being significantly larger and therefore heavier than traditional bench presses. This is more costly and discourages their use in private homes.

f. Not enabling the lifter to use the device with a human spotter.

Summary of the Invention

The present invention relates to a safety device for supporting a barbell above a weightlifting bench, and to an apparatus comprised of the safety device in combination with a weightlifting bench.

Generally, the apparatus is comprised of first and second spaced, elongated uprights positionable on opposite sides of the head or upper end of a weightlifting bench head end. Each of the uprights includes a slotted, elongated outer housing, a rod longitudinally aligned within the housing, and a sleeve slidable on the rod between raised and lowered positions. A horizontal barbell support arm is attachable to the inner end at various positions along the sleeve and extending outwardly from the housing through a first slot in the direction of the bench. The support arms are parallel and lie in a horizontal plane above the bench, with the arm intersecting the path of the barbell when it is being lifted.

First and second hydraulic cylinders are positioned alongside the first and second uprights respectfully. Each hydraulic cylinder is of a conventional design and is comprised of a tubular section with a hydraulic fluid inlet adjacent its lower end. A rod projects outwardly from the upper end of the cylinder. The inner end of the rod is connected to a piston within the cylinder. When hydraulic fluid enters the interior of the tubular section, the rod telescopes outwardly from the tubular section. The distal end of each cylinder is connected to an upright sleeve and the tubular section is affixed to the upright housing. Thus, as the rod is extended under the pressure of hydraulic fluid, the sleeve and attached support arm is caused to move upwardly.

The present invention also includes an accumulator for actuating each hydraulic cylinder. The accumulator has a pressure vessel casing containing a compressible medium and a hydraulic fluid, wherein the compressible medium is precharged to a desired pressure to exert a force on the hydraulic fluid. The accumulator is connected through a hydraulic fluid valve to fluid lines connected to each hydraulic cylinder. When the hydraulic fluid valve is opened, fluid flows from the accumulator to the hydraulic cylinders.

In the preferred embodiment, the accumulator has no internal moving parts. In this embodiment, the accumulator's pressure vessel casing encloses an upper internal region and a lower internal region. The accumulator's lower internal region is filled with hydraulic fluid and its upper internal region is filled with a compressible medium, preferably air. Hydraulic lines serve as fluid conduits between the hydraulic cylinders and the accumulator's lower internal region. The hydraulic lines are connected to a three-way hydraulic valve that controls and directs the flow of hydraulic fluid between the accumulator and the hydraulic cylinders. The three-way hydraulic valve has a first position that only allows hydraulic fluid to flow to the hydraulic cylinders, a second position that only allows hydraulic fluid to flow into the accumulator and a third position that allows the hydraulic fluid to travel in either direction.

The hydraulic lines or alternately, the three-way valve is connected to one or more ports that pass through the pressure vessel casing into the lower internal region of the accumulator. Moreover, one or more flow dispersion devices such as a baffle can be positioned within the hydraulic lines or ports to prevent an excess of air bubbles from forming in the hydraulic fluid.

In the preferred embodiment, there is no partition separating the hydraulic fluid from the compressible medium. Therefore, to prevent the compressible medium from flowing into the hydraulic lines during actuation of the cylinders, the ports to the hydraulic lines should be located below the lowest expected level of hydraulic fluid. Thus, it is preferred that the ports to the hydraulic lines are located near the lowest level of the accumulator's lower internal region.

It is important to note that neither the compressible medium nor the hydraulic fluid needs to be pumped during an actuation of the hydraulic cylinders. Instead, the force needed to lift the hydraulic cylinders is provided by the release of energy stored as a result of the

precharge compression of the compressible medium. Thus, as long as the initial precharge of compressible medium is preserved by not allowing significant portions to be released, there is no need for either a hydraulic or pneumatic pump.

However, as a practical matter the invention may further include a manual pressure release valve to allow an operator to decrease the lifting force supplied from the accumulator by venting a significant portion of the compressible medium to the atmosphere. In order to avoid spilling hydraulic fluid, it is preferred that the manual valve be ported through the uppermost portion pressure vessel casing into the accumulator's upper internal region. It is also preferred that the manual pressure release valve be of the type that can be incrementally opened to release pressure at a rate proportional to the valve's degree of openness.

The invention may also include a compressible medium pump for recharging the accumulator with compressible medium whenever the operator desires to increase the lift force provided by the accumulator. Since the preferred compressible medium is air, the compressible medium pump can be an air pump for recharging air to the accumulator. Preferably, the air pump is a foot operated air pump connected to the accumulator by way of an air line in communication with the upper internal region enclosed by the pressure vessel casing. The air line may include a desiccant to prevent moisture build-up inside the accumulator.

The invention may further include a pressure indication gauge in communication with the pressure inside the accumulator to indicate the potential lift force that can by provided by the accumulator. It is also preferred that the accumulator have a safety pressure release valve at or near the upper most portion of the accumulator's upper internal region. The safety pressure release valve has closed and open positions. As long as the pressure inside the accumulator is within a predetermined safe pressure limit, the safety release valve will remain

in the closed position sealing the pressure vessel casing. However, if the pressure inside the accumulator begins to exceed the predetermined safe pressure limit, the safety pressure release valve will switch to its open position and release a portion of the compressed medium to the atmosphere, thereby preventing a dangerous pressure buildup within the accumulator.

A turbulence-reducing medium can be included within the pressure vessel casing to prevent fluid from being sprayed out of the safety pressure release valve. The turbulence-reducing medium is preferably a rigid mesh or set of fins placed inside the accumulator for preventing a sloshing of hydraulic fluid during transient events caused by cylinder actuation and/or pressure release.

In another embodiment, the accumulator is a pressure vessel casing enclosing a first compartment and a second compartment, including a partition between the first compartment and the second compartment. The partition can be a flexible membrane that expands into either the first or second compartment in response to a pressure difference between the two compartments. The partition prevents a compressible medium in one compartment from coming into contact with a hydraulic fluid contained in the other compartment. Hydraulic fluid lines are ported into the compartment containing the hydraulic fluid and are connected through one or more hydraulic valves to the hydraulic cylinders.

The apparatus may further include a user support bench, which is preferably of sufficient length to support the user's head and torso. When combined with the safety device, the head of the bench is mounted between the uprights. Preferably, the head of the bench can be raised and lowered. For example, a vertically adjustable bench support bar may extend between the uprights, with the head of the bench being supported on the bench support bar. An additional horizontal mounting bar may be used to attach the uprights to each other. The

uprights may also include barbell rests attachable at various locations along the upright housings.

In order to control the position of the support arms, the apparatus includes a controller accessible by the user when reclined on the bench. This controller, which may be foot-operated, is used to open the hydraulic valve, thereby causing pressurized hydraulic fluid to enter the hydraulic cylinders. As a result, the rods of the hydraulic cylinders are extended, raising the support arms and lifting the barbell away from the user. The hydraulic valve may be partially opened towards its first position to release a limited volume of fluid to only partially support the barbell, or fully opened to overcome all of the barbell weight, lifting the barbell from the user without the user's assistance.

Objects and Advantages

Accordingly, several objectives and advantages of my invention are:

a. to provide a new and novel safety device or apparatus for an individual engaged in the activity of weight lifting.

b. To provide a new and novel device that acts instead of a spotter (eliminates need for spotter).

c. To provide a device that enables the lifter to easily adjust the rate at which the device assists (raises the weight from) the lifter.

d. To provide a device that enables the lifter to easily adjust the amount of assistance provided by the machine.

e. To provide a device easily set up that can either assist in lifting the weight or lift the weight in its entirety.

f. To provide a device that when actuated, enables the lifter to continue performing repetitions while being assisted.

g. To provide a device that when actuated by the lifter, does not allow any downward movement of the weight.

h. To provide a device that does not require electrical power.

i. To provide a device that can be used with a traditional human spotter.

j. To provide a device with a shape, weight and size similar to traditional manual machines.

k. To provide a device that is adjustable to the lifters body size (arm length).

l. To provide a device that enables the user to exercise with the seat in incline, flat, and decline positions.

Further objectives and advantages of my invention will become apparent from a consideration of the drawings and ensuing description.

Brief Description of The Drawings

Figure 1	Self Spotting Safety Bench press Composite
Figure 2	Inner and Front Side of Upright
Figure 3	Outer Side of Upright
Figure 4	Upright Internal and External Attachments
Figure 5	Lifting Arm
Figure 6	Adjustable Seat and Weight Rest
Figure 7	Adjustable Seat and Weight Rest
Figure 8	Hydraulic & Pneumatic System
Figure 9	Free Weight Resting Position
Figure 10	Preferred Accumulator
Figure 11	Alternate Accumulator

List of Reference Numerals for Figures 1-9

1 Upright

2 Upright support

3 Cross bar

4 Seat

5 Seat support bar

6 Slide bar

7 Slide

8 Lifting arm

9 Hydraulic cylinder slide attachment

10 Hydraulic cylinder upright attachment

11 Hydraulic cylinder

12 Adjustable weight rest and seat bar support

13 Actuator

14 Slide bearing

15 Accumulator

16 Accumulator pump

17 Accumulator air supply line

18 Hydraulic cylinder fluid supply line

19 Adjustable hydraulic fluid flow valve

20 One way hydraulic flow valve (to cylinder)

21 One way flow valve (to accumulator)

22 Actuator cables

23 Weight rest support holes

24 Lifting arm slot

25 Hydraulic cylinder slide attachment slot

26 Lift arm support holes

27 Lift arm semi circles

28 Support pins

29 Cap

30 Centering plate

31 Floor plate

32 Seat support bar

33 Barbell

5

List of Reference Numerals for Figures 10 and 11

34 Preferred accumulator

35 Pressure vessel casing

36 Upper internal region

37 Lower internal region

38 Hydraulic fluid

39 Compressible medium

40 Hydraulic lines

41 Three-way valve

42 Valve first position

43 Valve second position

44 Valve third position

45 Port

46 Flow dispersion device

47 Manual pressure release valve

48 Compressible medium pump

49 Air line

50 Desiccant

51 Pressure indication gauge

52 Safety pressure release valve

53 Turbulence-reducing medium

54 Alternate accumulator

55 Pressure vessel casing

56 First compartment

57 Second compartment

58 Partition

59 Compressible medium

60 Hydraulic fluid

61 Hydraulic fluid line

Detailed Description of The Invention

In the following description, terms such as horizontal, upright, vertical, above, below, beneath, and the like, are used solely for the purpose of clarity in illustrating the invention, and should not be taken as words of limitation. The drawings are for the purpose of illustrating the invention and are not intended to be to scale.

Figure 1 shows a composite drawing of the device. There are 2 uprights (1a, 1b) parallel to each other and tilted slightly away from the longer side of the seat (4). Two adjustable weight rests and seat supports (12a, 12b) are located on the inner side of each upright. Protruding from the front of each upright (1a,1b) is a lifting arm (8a,8b) that extends perpendicular to gravity, and in the direction of the seat (4). Each upright (1a,1b) has a support (2a shown only) and is connected to the other via a cross bar (3). Mounted on the cross bar is an Accumulator (15). The accumulator is attached to a pump (16) via an air supply line (17). The other end of the accumulator is connected to hydraulic cylinders (11a, 11b) via a fluid supply line (18). The hydraulic cylinders (11a, 11b) are mounted at one end to the bottom of an upright (1a, 1b) on the hydraulic cylinder upright attachment (10), and the other end to the hydraulic cylinder slide attachment (9a, 9b) that protrudes from the outer side of each upright (1a, 1b). Above the center of the cross bar (3) is an adjustable seat support bar (32) that supports one end of the seat (4). The other end of the seat is supported by an adjustable vertical seat support (5). Attached to the vertical seat support, close to the floor is an actuator. Actuator cables (22) extend from the actuator to hydraulic fluid valves (see Figure 8).

Figure 2 focuses on upright (1b). The inner side and front side of upright (1b) contains weight rest support holes (23) extending partially down the upright. The front of upright (1b) to the right of the holes contains a lifting arm slot (24).

Figure 3 shows the outer side of the upright (1b) containing a hydraulic cylinder slide attachment slot (24) and a hydraulic cylinder upright attachment (10). Contained within the upright are centering holes for holding the slide bar (6b) that can be seen in figure 4.

Figure 4 shows the parts an upright (1b) contains without the upright itself included. The slide bar (6b) nearly extends the full length of the upright (1b). Mounted on the slide bar (6b) is the slide (7b), which has been fastened with the hydraulic cylinder slide attachment (9b). In addition, the slide has lift arm support holes (26) and slide bearings (14) at either end. The lifting arm (8b) is able to be mounted on the slide (7b) in various positions.

Figure 5 shows lifting arm (8). The slide contact of the lifting arm (8) contains two semi circles (27a, 27b). The first is directly behind the arm extension (27a) to contact the front of the slide. This semicircle contains a pin at its center that coincides with the lift arm support holes (26). The second semi circle (27b) contacts the back of the slide. This contact point is higher on the slide (7b) (figure 4) than the first semicircle. This semicircle arrangement causes the lift arm pin (28) to slide out of the lift arm support hole (26) (figure 4) when the tip of the arm is raised (the pivot pint roughly being between the upper and lower semicircles). This action also causes the semi circles to no longer tightly contact the slide (7b), permitting movement of the lifting arm up and down the slide (7b) enabling adjustment.

Figures 6 and 7 show the adjustable seat and weight rest (12b). This piece is "u" shaped to partially wrap around an upright (1b). It contains two mounting pins. The first pin is located on the backside of the front plate containing the barbell support extension. The second pin is located on the side plate to extend into the inner weight rest support holes (23). Pin location coincides with the weight rest support holes (23). Pin location allows the front pin to slide into the rest support hole (23) when the adjustable seat and weight rest (12b) is rotated clockwise 90 degrees. With the first pin seated in the support hole, rotation of the

adjustable weight rest (12b) 90 degrees counter clock wise (with the front pin within the support hole (23) being the axis of rotation) seats the inner pin in the inner rest support hole (23). This part also has a semicircle attachment mounted on its inner most face. This semicircle is of suitable size and shape to support the seat support bar (32) when attached to an upright.

Figure 8 shows the Hydraulic and Pneumatic system that powers the self-spotting bench. The accumulator (15) is connected at one end to an air pump (16) via an air line (17). A hydraulic line (18) exits the accumulator (15) from the other end and leads to three valves; one-way valve to cylinder (20), one-way valve to accumulator (21), and the flow rate valve (19). The hydraulic line then splits and leads to each hydraulic cylinder (11a, 11b).

Turning now to Figure 10, another embodiment for an accumulator (34) has no moving parts and no internal partition. Accumulator (34) has a pressure vessel casing (35) that encloses an upper internal region (36) and a lower internal region (37). Lower internal region (37) is filled with a hydraulic fluid (38). Upper internal region (36) is filled with a compressible medium (39) such as air. Hydraulic lines 40 serve as fluid conduits between the hydraulic cylinders of figure 1 and lower internal region (37). Hydraulic lines (40) are connected to a three-way hydraulic valve 41 that controls and directs the flow of hydraulic fluid between accumulator (34) and the hydraulic cylinders of figure 1. Three-way hydraulic valve (41) has a first position (42) that only allows hydraulic fluid (38) to flow to the hydraulic cylinders, a second position (43) that only allows hydraulic fluid (38) to flow into accumulator (34) and a third position (44) that allows hydraulic fluid (38) to flow in either direction.

Three-way valve (41) is connected to a port (45) that passes through pressure vessel casing (35) into lower internal region (37). Also, a flow dispersion device such as a baffle

(46) is connected to port (45) to prevent excess air bubbles from forming in hydraulic fluid (38).

A manual pressure release valve (47) allows an operator to decrease the lifting force supplied from accumulator (34) by venting a significant portion of compressible medium 39 to the atmosphere. Moreover, a compressible medium pump (38) is included to recharge accumulator (34) with compressible medium (39) whenever the operator desires to increase the lifting force providing by accumulator (34). Preferably, compressible medium pump (38) is a foot-operated air pump connected to the accumulator by way of an air line 49 in communication with upper internal region (36). A desiccant 50 is included within air line 49 to prevent moisture build-up inside accumulator 34.

A pressure indication gauge (51) is in communication with upper internal region (39) to indicate the potential lift force that can be provided by accumulator 34. Furthermore, a safety pressure release valve (52) is in communication with upper internal region (39) and will vent compressible medium (39) to the atmosphere in the event the pressure inside accumulator (34) begins to approach a predetermined safe pressure limit.

A turbulence-reducing medium (53) is also enclosed by pressure vessel casing (35) to prevent hydraulic fluid (38) from being sprayed out of safety pressure release valve (52). Figure 10 depicts turbulence-reducing medium (53) as a rigid mesh. However, turbulence medium (53) can also be a set of fins or a set of baffle plates or practically any other type of fluid damping medium.

Figure 11 shows another alternate accumulator (54) made up of a pressure vessel casing (55) having a first compartment (56) and a second compartment (57). Compartments (56) and (57) are separated by a partition (58) made from a continuous flexible membrane that prevents a compressible medium (59) in first compartment (56) from coming into contact

with a hydraulic fluid (60) in second compartment (57). At least one hydraulic fluid line (61) is in communication with second compartment (57) to direct hydraulic fluid to and from hydraulic cylinders. Similar to accumulator (15) shown in FIG. 1, alternate accumulator (54) can be positioned horizontally underneath seat 4.

Operation

Figure 9 shows the barbell (33) free weight starting point held on the adjustable weight rest and seat bar support (12). The distance from the seat (4) (and therefore the lifter) can be adjusted by rotating each adjustable weight rest 90 degrees away from the upright (1a, 1b) using the front pin as a pivot point. After being rotated, the adjustable weight rest and seat bar support (12) can be separated from the upright (1) by moving it perpendicular to the upright in the direction the lifting arm (8) extends. The adjustable weight rest and seat bar support (12) can be reattached in other locations performing the reverse of these instructions in any other weight rest support hole (23).

The lifting arm range location can be adjusted upward and downward to the lifters preference. This is done by tilting the tip of the lifting arm (8a, 8b) upward, causing the semicircles (27) to separate from the slide (7) and the support pin (28) to slide out of the lift arm support hole (26). In this position, the lifting arm can be slid up and down the slide (7) then relocated in another position.

With the barbell held on the adjustable weight rest (12a, 12b) the lifter can now set the one-way flow valve to accumulator (21) to be active. This will allow the lifting arms (8a, 8b) to only move downward. The lifter has two options as to how to depress the lifting arms (8a, 8b). The first option is to get in the exercising position, remove the barbell (33) from the adjustable weight rest (12a, 12b) allowing the weight to lower and depress the lifting arms (8a, 8b), and then start repetitions from the lowest point the bar traveled. The second option is to depress each lifting arm (8a, 8b) by hand to a point where it will not interfere with the exercise until released.

If the lifter desires an increased or decreased assisting force exerted on the barbell by the lifting arms, an air adjustment can be made to the accumulator by either pumping (16)

more air in or releasing air. If the rate at which the lifting arm ascends is too slow or fast, the adjustable hydraulic fluid flow valve (19) can also be manipulated to suit user preference.

With the lifting arms depressed and equipment adjusted to suit lifter preferences, the repetitions are started. When the lifter needs a "spot" the one way flow valve (to accumulator) is released. The compressed air in the accumulator (15) acts as a spring and forces hydraulic fluid through the hydraulic cylinder fluid supply line (17) and into the hydraulic cylinder (11a, 11b). The cylinder shaft then raises the slide (7) causing the attached lifting arm to also rise. The lifting arms contact the barbell and assist (spot) the lifter. The opposite of this action occurs when the lifting arms are being depressed (i.e. the hydraulic fluid in the hydraulic cylinders (11a, 11b) is forced back into the accumulator where potential energy is stored in the form of compressed air.

With the one-way flow valve (to accumulator) (21) released, the lifting arms (8) will be permitted to move up and down while still asserting an assisting force on the barbell (33). This allows the lifter to continue by performing assisted repetitions when he/she could no longer lift the original weight unassisted. Should the upward force desired by the lifter exceed the weight of the barbell the entire weight will be lifted by the machine, not permitting assisted repetitions.

When the lifter is no longer able to perform the assisted repetitions (or whenever else the lifter desires) the one way flow valve (to cylinder) (20) can be engaged. This will only allow hydraulic fluid to flow toward the cylinders (11a, 11b), thus allowing the lifting arms to raise but not be lowered. This will allow the lifter to lift the barbell with assistance, and then prevent the barbell (33) from falling on the lifter when failure occurs.

The manipulation of the one-way flow valves (21,22) mentioned above is accomplished by use of an actuator (13) the exerciser manipulates with his/her lower leg or foot. The Actuator (13) is connected to the hydraulic valves via actuator cables (22) and pulley transmission system. When the actuator (13) is kicked once in the direction of the accumulator (15) the one-way valve to the accumulator (21) will be released. When kicked a second time the one-way valve to the cylinder (20) will be engaged. The system can then be reset by either kicking the actuator (13) a third time or manually resetting the one way flow valves (21,22).

Due to the stress the exerciser is experiencing during failure, the exercisers leg or foot is likely to contact the actuator with significant force. The actuator therefore has a limited range of motion and does not transfer all of this energy to the valves. For the same reason, the actuator is constructed with suitable smooth surface area as to not injure the exerciser when kicked. The design of the actuator (13) shown in figure 1 is not intended to limit the scope of this invention. A lanyard that attaches to the exercisers leg or foot is also feasible.

Thus the reader will see that the self-spotting safety bench press of this invention provides a dependable spotting machine that increases user safety. The spotting speed and force exerted is fully adjustable to suit user preferences, as is the spotting arm range location, weight rest position, and seat position. This machine has two spotting modes. The first mode allows the lifter to continue repetitions (up and down) assisted by the machine. The second mode only allows upward movement, preventing the weight from falling on the lifter. Furthermore, this machine requires no electrical power and is of a weight and size similar to traditional non-spotting bench presses. These attributes make this machine more likely to be used in homes and other private residences.

While the above description contains much specificity, these should not be construed as limitations on the scope of the invention, but rather as an exemplification of one preferred embodiment thereof. Many other variations are possible. For example, the uprights described above do not have to be tilted away from the seat extension of the bench. Still, another example is that the spotting device used with this machine is not to be limited to use with only one type of seat. A seat adjustable to various incline, decline and flat positions and seats in fixed positions are all types that can be used with this device.

Accordingly, the scope of the invention should be determined not by the embodiments illustrated, but by the appended claims and their legal equivalents.